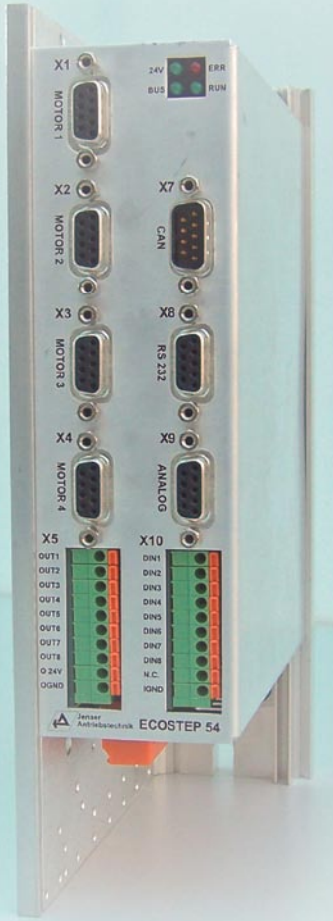
Jenaer Antriebstechnik GmbH



User Manual **ECOSTEP®54**

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Jenaer Antriebstechnik GmbH
Buchaer Straße 1
07745 Jena

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1 About this manual

This user manual describes the stepper amplifier series ECOSTEP®54. It concerns all persons who install, commission and operate ECOSTEP®54 drives.

Further information:
Programming: manual „Object Dictionary ECOVARIO® and ECOSTEP®“
Motor data: Data sheets series 17S and 23S (stepper motors).

This manual makes the following demands on qualified personnel:
Transport: Personnel trained in handling electrostatic sensitive devices
Installation: Electrotechnically qualified personnel who know the security directives of electrical engineering and automation
Setup/Commissioning: Qualified personnel with a broad knowlege of the fields of electrical engineering, automation and drives

2 Safety instructions

2.1 Symbols

Table 2.1: Symbols

Pictogram	Warning	Consequences
	General warning about danger	Disregarding this warning may lead to death or serious injuries.
	Warning about dangerous electrical voltages	Disregarding this warning may lead to death or serious injuries.
	Warning about hot surfaces	Disregarding this warning may lead to burns to the skin.

2.2 General notes

Only properly qualified personnel are permitted to perform activities such as transport, installation, commissioning and maintenance of the ECOSTEP®54.

The manufacturer of the machine must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

In case of modifications or retrofits with components of manufacturers other than Jenaer Antriebstechnik, please contact us to clarify that those components are suitable to be assembled with our devices.

Emergency-off equipment must be workable in all operation modes, especially during setup and maintenance.

2.3 Dangerous voltages

Never open the units during operation. Covers and cabinet doors have to be kept closed during operation.

The protective earth conductor has to be properly applied before applying a voltage.

During operation logic and power conductors are live. Never undo electrical connections while they are live!

After disconnecting the device wait at least 3 minutes before touching contacts. Capacitors can still have dangerous voltages present up to 3 minutes after switching off the supply voltage. To be sure measure the DC link circuit and wait till it has fallen below 40 V.

2.4 Danger by hot surfaces

Hot surfaces may cause burns to the skin. As the housing of the ECOSTEP®54 serves also as heat sink during operation the surface temperature may rise to more than 70 °C.

2.5 Danger by unintentional mechanical movements

Unintentional movements of motors, tools or axes may lead to death or serious injuries. ECOSTEP®54 drives can produce strong mecanical powers and high accelerations. Avoid staying in the danger zone of the machine. Never switch off safety equipment! Malfunctions should be repaired by qualified personnel immediately.

2.6 Prescribed use

The stepper motor amplifiers ECOSTEP®54 are components which are built into electrical equipment or machines and can only be used as integral components of such equipment. All notes about technical data and ambient conditions have to be observed.

Using the unit in hazardous locations and in ambients containing oil, gas, vapours, dusts, radiations etc. is prohibited if it is not explicitly allowed.

The manufacturer of the machine must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

If one or more servo amplifiers ECOSTEP®54 are built into machines or plants the intended operation of the servo amplifier is forbidden until it has been established that the machine or plant fulfills the requirements of the EC Machinery Directive 98/37/EC and the EMC Directive 89/336/EEC. Further EN 60204 and EN ISO 12100 parts 1 and 2 have to be observed.

3 Legal notes

3.1 Terms of delivery

Our terms of delivery are based on the „The General Terms of Delivery for Products and Services of the Electrical Industry“ (German: ALB ZVEI) of the Central Association of the Electrical and Electronics Industry (ZVEI e.V.) in their current version.

3.2 Liability

The circuits and procedures in this manual are proposals. Every user has to check the suitability for every special case. Jenaer Antriebstechnik GmbH is not responsible for suitability. Especially Jenaer Antriebstechnik is not responsible for the following damage causes:

- disregarding the instructions of this manual or other documents concerning ECOSTEP®54
- unauthorized modifications of drive, motor or accessories
- operating or dimensioning faults
- Improper use of the ECOSTEP®54 components

3.3 Standards and directives

Stepper motor amplifiers ECOSTEP®54 are components intended to be built in machines or plants for industrial purposes.

ECOSTEP54 complies to the standards and directives listet in the appendix, chapter 9.4.

3.3.1 UL/CSA compliance acc. to UL 508C

The stepper motor amplifiers ECOSTEP 54 are designed in compliance with UL or cUL respectively.
For further information see UL file number E244038 at www.ul.com.

3.3.2 CE compliance

Stepper motor amplifiers ECOSTEP®54 are components that are intended to be built into electrical plant and machines for industrial use. The manufacturer of the machine is responsible that the machine or plant fulfills the requirements of the EMC directive.
The stepper motor amplifiers ECOSTEP®54 have been tested by an authorized testing laboratory in a defined configuration with the system components which are described in this documentation.
Any divergence from the configuration and installation described in this manual means that you will be responsible for carrying out new measurements to ensure that the regulatory requirements are fulfilled.

Jenaer Antriebstechnik GmbH

Buchaer Straße 1 · 07745 Jena · Germany
Tel. +49 (0) 3641 60 88 90
Fax. +49 (0) 3641 608901

DECLARATION OF CONFORMITY

We

Jenaer Antriebstechnik GmbH
Buchaer Straße 1
07745 Jena
Germany

declare that the product

Product Group:	Servo Drive
Type:	ECOSTEP®54-XX-XXX-XXX

is in conformity with the

EU Directive 89/336/EWG	(EMC Directive)
Applied harmonised standards:	EN 61800-3 (EMI Disturbance) EN 61800-3 (EMI Immunity)
EU Directive 73/23/EWG:	(Low Voltage Directive)
Applied harmonised standards:	EN 61800-5-1 EN 60204

and with the following international standards

Power Conversion Equipment (USA): Industrial Control Equipment (Canada):	UL 508C File No.: E244038 CSA C22.2 No. 14-M05

Issued by:	Jenaer Antriebstechnik GmbH Dipl.-Ing. Udo Penndorf
Location, Date:	Jena, 20.02.2007
Signature:	

4 Technical Data

4.1 Technical data of the power stage

Table 4.1: Technical data of the power stage

Number of motor outputs		4
Max. phase currrent	A	2.5
Step resolution	Steps/rev.	12,800
Max. output voltage	V_{DC}	U_{DC-BUS} , cf. table 4.2
Max. output power	W	4 x 100
Short-circuit strength of motor output	current limiting in case of short circuit of motor phases against each other and against U_{DC-BUS}	
Minimum inductance of motor winding	mH	min. 1
Length of motor cable	m	max. 10*
Frequency of output current ripple	dependent on current and inductance	
*) Please consult our application department in case of longer cables.		

4.2 Electrical connection data

Table 4.2: Electrical connection data

Logic supply	V_{DC}	20 ... 30, max. 200 mA
Protection required for logic supply	A	3 T
Power supply (U_{DC-BUS})	V_{DC}	24 ... 45
Protection required for power supply	A	10 slow-acting*
*) if required, use an UL-certified automatic circuit breaker 10 A, 60 V_{DC} slow-acting		

4.3 Operating Conditions

Table 4.3: Operating conditions

Ambient temperature	°C	0 ... + 40
Storage temperature	°C	- 10 ... + 70
Air humidity (non-condensing)	5 ... 95% (RH-2 acc. to IEC 61131-2)	
Pollution severity	2 acc. to IEC 61131-2	
Protection class	IP20	
Mounting position	vertical	
Installation altitude	up to 1000 m above mean sea level w/o restriction	
Power loss: if 4 axes traverse with 2.5 A	W	approx. 30
Cooling by means of convection. Heat sink required in case of restricted convection.		

4.4 General technical data

Table 4.4: General technical data: control signals

No.	Control signal	Unit	
1	24 V supply (current draw without outputs)	V_{DC}	24 ±10 %
		A	0.8
8	Digital control signal inputs (user-programmable, or as limit switch inputs)	V_{DC}	LOW 0 – 4, HIGH 13 – 30
		mA	3.4 / 2.4 (at 24 V_{DC})
		kΩ	7
1	Control signal DC link relay (REL+, REL-)	V_{DC}	20 ... 24
		mA	50
8	Digital control signal outputs (4 user-programmable, 4 resereved for holding brakes)	V_{DC}	24 (20 ... 30)
		A	0.5
			Holding brake: max. 0.8 / 0.4 A (100 ms / continuous)
4	Analog inputs		0 V ... +5 V, 10 bit resolution
		kΩ	at DC: R > 250 at f > 250 Hz: R < 15
1	Analog output		-10 V – +10 V, 8 bit resolution

Table 4.5: General technical data: dimensions and weight

Dimensions and weight	Unit	
Dimensions without heat sink (w x h x d)	mm	240 x 62 x 170 (without mating connector)
Dimensions with heat sink (w x h x d)	mm	240 x 102 x 170 (without mating connector)
Weight (without heat sink)	kg	1.8 kg
Weight (with heat sink)	kg	3.4 kg

4.5 Modes for setpoint setting

ECOSTEP®54 provides the following modes for setpoint setting:

- Online positioning via field bus (RS232, CANopen)
- Positioning control via SPS interface (digital inputs/outputs)
- Joystick operation (analog inputs, resolution 10 bit).

4.6 Suitable types of motors

With ECOSTEP®54 stepper motor amplifier various types of stepper motors can be operated, among others the stepper motor series 17S und 23S of Jenaer Antriebstechnik GmbH. Technical data and regulations in this manual only refer to these motors. Technical data of the motors can be retrieved from the motor data sheets or from our homepage www.jat-gmbh.de.

5 Installation

5.1 Mounting

5.1.1 Important notes

- Make sure that transport and storage did no damage to the units.
- The ambient air must not be polluted by dust, greases, aggressive gas etc. Eventually appropriate countermeasures have to be taken (installation of filters, frequent cleaning).
- Depending on the power losses an appropriate ventilation should be provided.
- Observe the mounting spaces.
- At installation locations with permanent vibrations or shocks damping measures should be taken into consideration.
- The device contains electrostatic sensitive devices which can be damaged by improper usage.

5.1.2 Dimensions

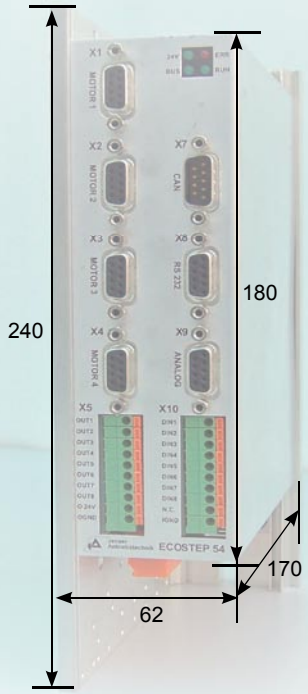


Fig. 5.1: Dimensions of ECOSTEP®54 [mm]

5.1.3 Assembly

When mounting the ECOSTEP®54 into the cabinet cable clamps (contained in connector kit AMK40, cf. chap. 8) assure that the connecting cables are laid EMC conform by connecting the cable shield extensively to chassis earth. Maximum cable diameter is 15 mm.
It is important that the air flow is not disturbed by components above or below the stepper motor amplifiers.
If a heat sink is used (cf. chap. 8.1.1), the mounting space will increase by 40 mm.
The surface of the mounting plate has to be conductive (e.g. zinc plated). Varnished mounting plates must not be used.

To calculate the minimal mounting depth (fig. 5.3, dim A) the form of the connectors (cable outlet direction) and the minimum bending radii of the connecting cables at the sub-D connectors have to be regarded.

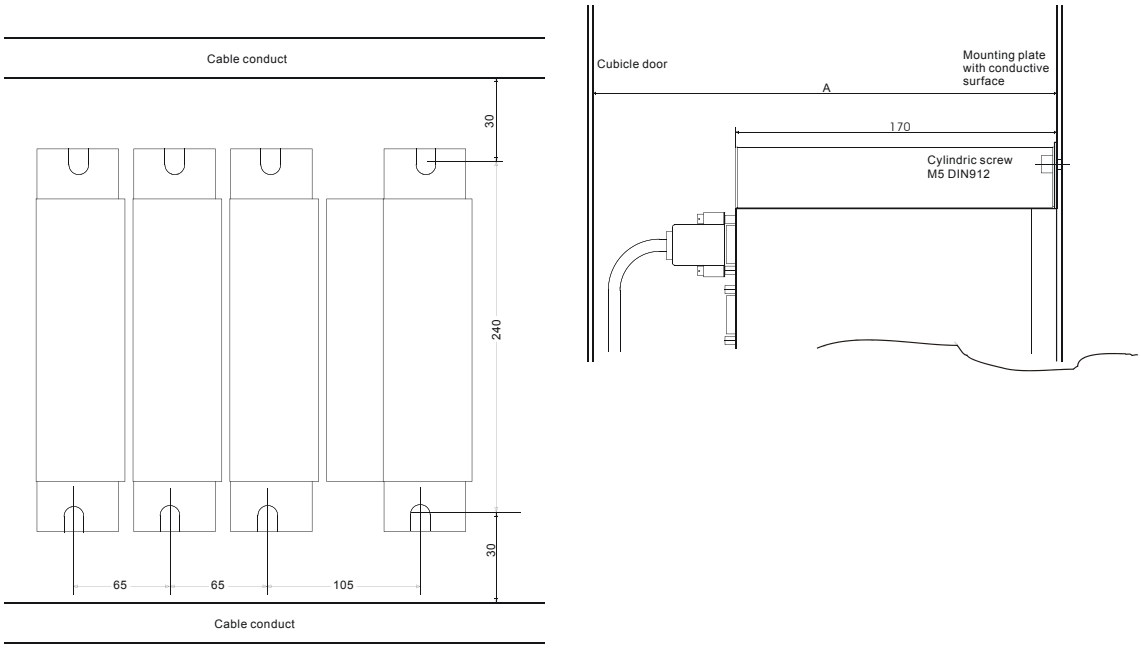


Fig. 5.3: Mounting dimensions cabinet, width and depth [mm]

5.2 Electrical Installation

5.2.1 Important notes

All installation work may only be carried out if the machine or plant is not live and protected against re-start.
Never exceed the maximum rated voltage at the connector X11 (power supply) X11! $\mathbf{U_{max} = 45V_{DC}}$
The guarding of the DC supply and the 24 V logic voltage should be carried out by the user
Stepper motor amplifier and motor have to be properly grounded. The protective earth conductor must have at least the same diameter as the supply cables. The stepper motor amplifier should be mounted onto a conductive (not varnished) metal mounting plate.

5.2.2 EMC compliant installation

The supply connection of the machine should be equipped with an appropriate RFI suppression filter. Always use shielded cables. Metal parts in the cabinet have to be interconnected extensively and and be conductive regarding HF. Used relays, contactors, solenoids etc. have to be protected against overvoltage. Supply cables and motor cables must be laid in a proper distance of control cables.

6 Interfaces

6.1 Arrangement of the interfaces

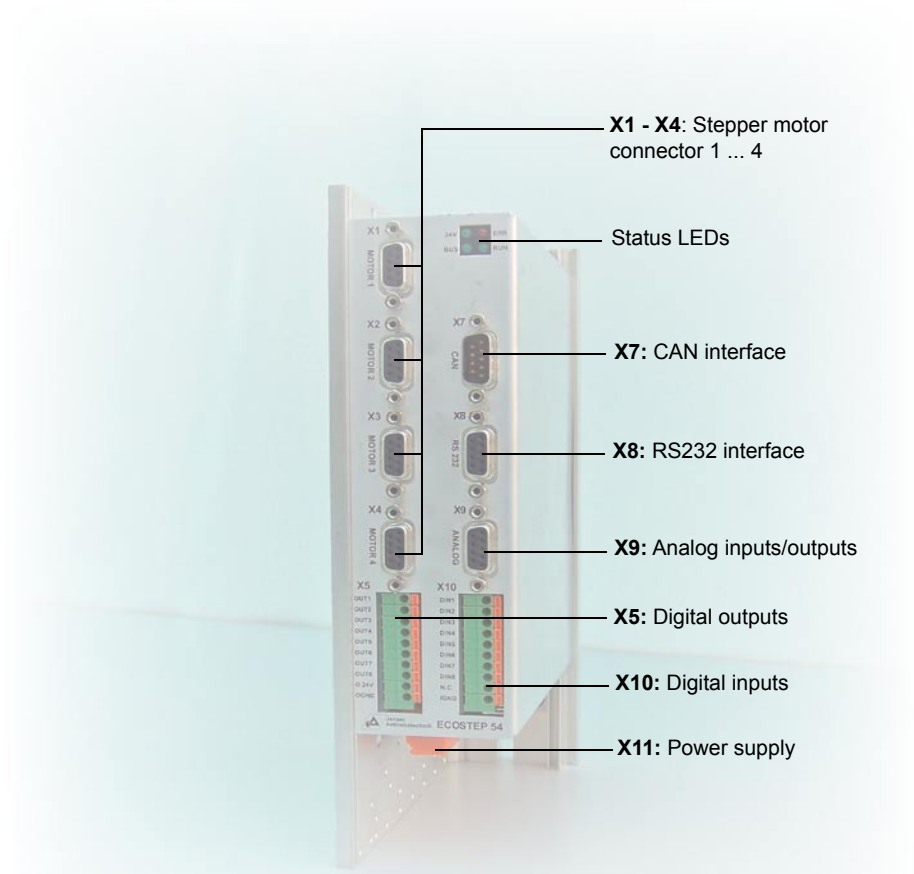


Fig. 6.1: Arrangement of the ECOSTEP®54 interfaces

A mating connector for interface X11 (socket connector 6-pole, WAGO type 231-306) is contained in the connector kit SMK40 (siehe Kap. 9).

Note: The width of the of the D-Sub mating connector handle must not exceed 31.5 mm. (e.g. Harting type 09 67 009 0443).

6.2 Control signals

The control signals are programmable (cf. manual „Object Dictionary ECOVARIO® + ECOSTEP®“).

6.2.1 X5: Digital outputs, 24 V

Table 6.1: Pin assignment connector X5

Signal	Pin	Description
OUT1	1	Digital output 1 (PLC output), $I_{O\,max}$ = 0.5 A
OUT2	2	Digital output 2 (PLC output), I_{Omax} = 0.5 A
OUT3	3	Digital output 3 (PLC output), I_{Omax} = 0.5 A
OUT4	4	Digital output 4 (PLC output), I_{Omax} = 0.5 A
OUT5	5	Digital output 5, reserved for holding brake motor 1 I_{Omax} = 0.5 A
OUT6	6	Digital output 6, reserved for holding brake motor 2 I_{Omax} = 0.5 A
OUT7	7	Digital output 7, reserved for holding brake motor 3 $I_{O\,max}$ = 0.5 A
OUT8	8	Digital output 8, reserved for holding brake motor 4 $I_{O\,max}$ = 0.5 A
O24V	7	24 V supply voltage for digital outputs
OGND	8	24 V ground

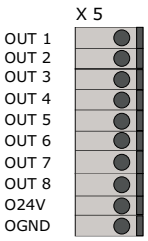


Fig. 6.2: Connector X5: 10-pole cage clamp terminal (cable diameter max. 0,75²)

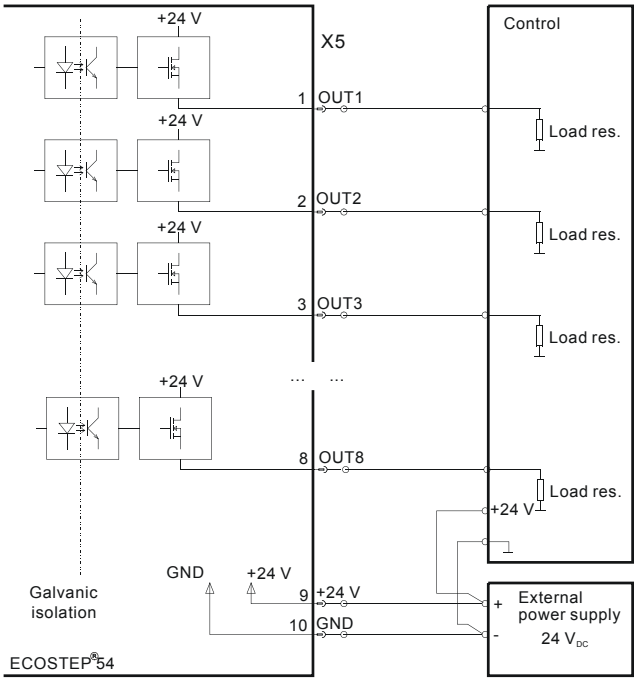


Fig. 6.3: Connector X5: Circuit of the digital outputs

6.2.2 X10: Digital inputs

Tabelle 6.2: Pin assignment connector X10

Signal	Pin	Description
DIN1	1	Digital input 1
DIN2	2	Digital input 2
DIN3	3	Digital input 3
DIN4	4	Digital input 4
DIN5	5	Digital input 5
DIN6	6	Digital input 6
DIN7	7	Digital input 7
DIN8	8	Digital input 8
n.c.	9	n.c.
IGND	6	external 24V ground

Digital inputs can be used e.g. for limit position switches

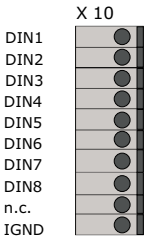


Fig. 6.4: Connector X10: 10-pole cage clamp terminal (cable diameter max. 0,75²)

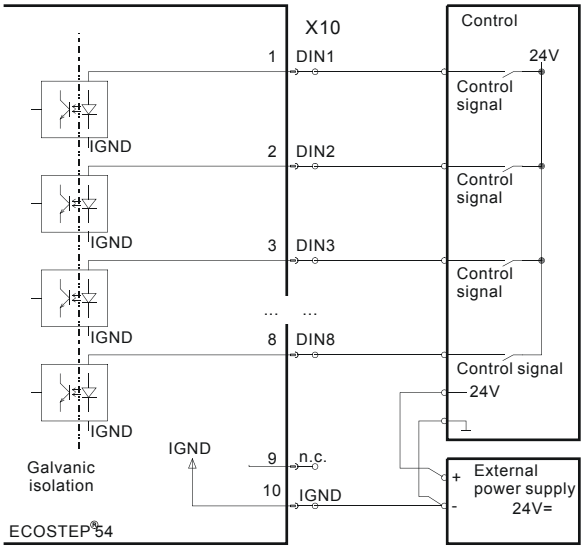


Fig. 6.5: Connector X10: Circuit of the digital inputs

6.2.3 X9: Analog inputs, analog output

Table 6.3: Pin assignment connector X9

Signal	Pin	Description	Value
AN0	1	Analog input 1	0 ... 5 V
AN1	2	Analog input 2	0 ... 5 V
AN2	3	Analog input 3	0 ... 5 V
AN3	4	Analog input 4	0 ... 5 V
GND	5	Internal GND	
+5V	6	Internal 5-V-supply	max. load 20 mA, unprotected!
n.c.	7	n.c.	
DA0	8	Analog output	+/- 10 V
GND	9	Internal GND	

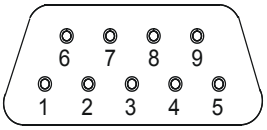


Fig. 6.6: Mating connector X9: 9-pole D-Sub connector, View of the solder or crimp side

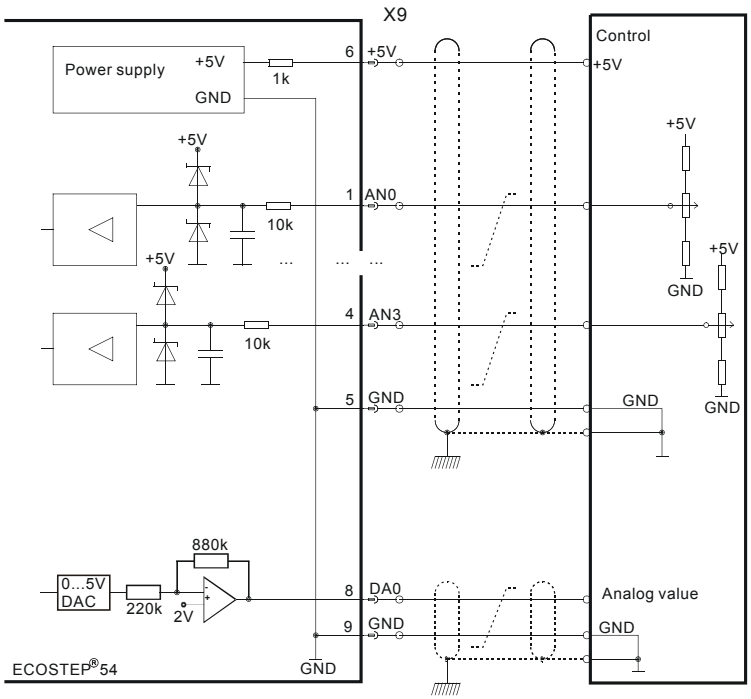


Fig. 6.7: Connector X9: Circuit of the analog inputs and the analog output

6.3 Power connection

6.3.1 X1 to X4: Motor connector

Table 6.4: Pin assignment connectors X1 to X4

Signal	Pin	Description
Phase A	4	Stepper motor connection
Phase /A	3	Stepper motor connection
Phase B	2	Stepper motor connection
Phase /B	1	Stepper motor connection
+24 V	5	Limit position switch supply
Brake +	6	Holding brake connection (+)
Limit position +	7	PLC input limit position +
Brake -	8	Holding brake connection (-)
Limit position -	9	PLC input limit position -
Shield	shroud	connected to GND via housing

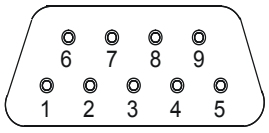


Fig. 6.8: Mating connector X1 to X4: 9-pole D-Sub connector, View of the solder or crimp side

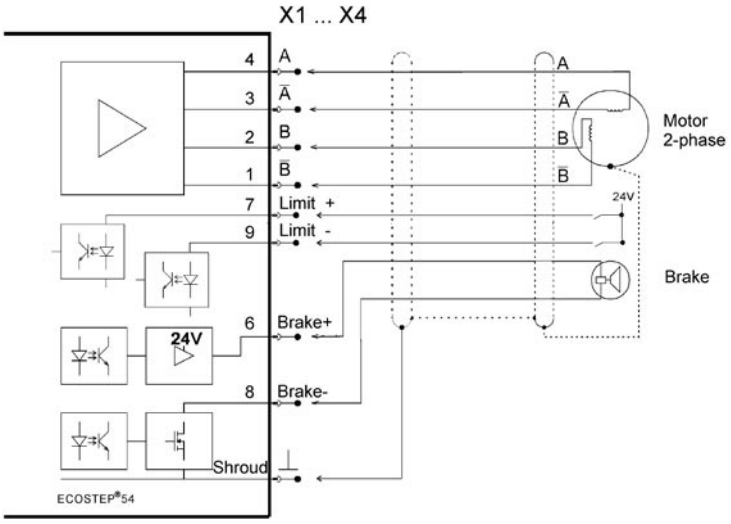


Fig. 6.9: Motor connection

6.3.2 X11: Supply voltage

Table 6.5: Pin assignment connector X11

Signal	Pin	Description
24 V logic supply	+24V	Incoming supply voltage +20 ... 30V_{DC} / max. 0.2 A
GND	GND	GND for logic supply
DC link relay +	REL+	Switching on the DC link
DC link relay -	REL -	Switching on the DC link
Power supply +	+ DC BUS	Incoming supply +24V...45V_{DC} / max. 8 A
GND	GND	GND for power supply

Fig. 6.10: Connector X6: 6-pole cage clamp terminal, max. cable diameter 1.5²

Appropriate power supply modules for stepper motor amplifier ECOSTEP®54 from the program of Jenaer Antriebstechnik:

- Power supply 24 V: switch-mode power supply ML70.100, Puls GmbH, 3 ... 5A
- Power suppy 45 V: switch-mode power supply SL10.101, Puls GmbH, 48 V, limit to 45 V.

Switching on the DC link
The DC link is switched on by applying a voltage of +24V_{DC} across REL+ und REL-.

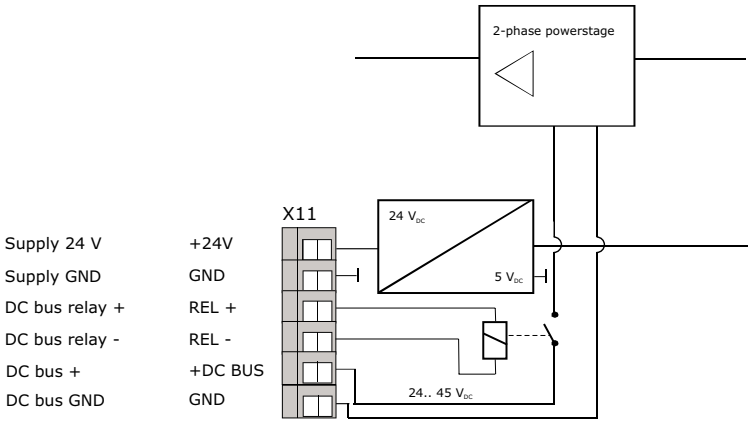


Fig. 6.11: Connector X11, circuit

Line filter
The user has to make sure to conform to the regulations of the EMC Directive (89/336/EEC) by appropriate measures (external line filter, EMC compliant wiring).

Fusing
For external fusing please consider the general technical data (cf. chapter 4.2).

6.4 X8: RS232 interface

The stepper motor amplifier ECOSTEP®54 can be completely programmed and parameterized by a PC via the RS232 interface. The connector X8 provides a pinout for direct cabling to a standard PC COM interface. Fat drawn wires are necessary for communication, other wires are for handshaking simulations for special PC programs. The transceiver inside ECOSTEP®54 meets the EIA-232E and CCITT V.28 specifications and provides ESD protection to IEC1000-4-2 (801.2).

Table 6.7: Pin assignment connector X8 R232 interface

Pin	Signal	Description
1	-	n.c.
2	TxD	RS232 TxD
3	RxD	RS232 RxD
4	-	n.c.
5	GND	Digital ground
6	-	n.c.
7	-	n.c.
8	-	n.c.
9	-	n.c.
shroud	Shield	connected to GND via housing

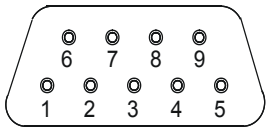


Fig. 6.12: Mating connector X8: 9-pole D-Sub connector, View of the solder or crimp side

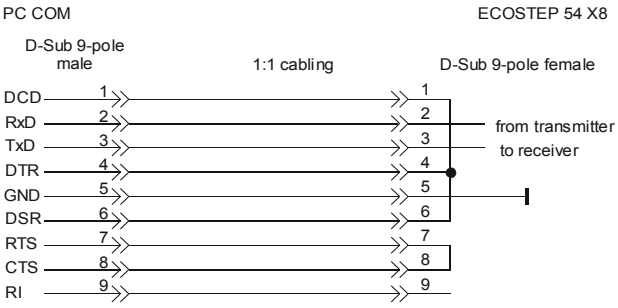


Fig. 6.13: Lines necessary for RS232 communication

The communication protocol provides network operation of up to 15 ECOSTEP®54 devices working as communication slaves in a mono master network. In that case the RS232 cabling must have a loop structure as follows:

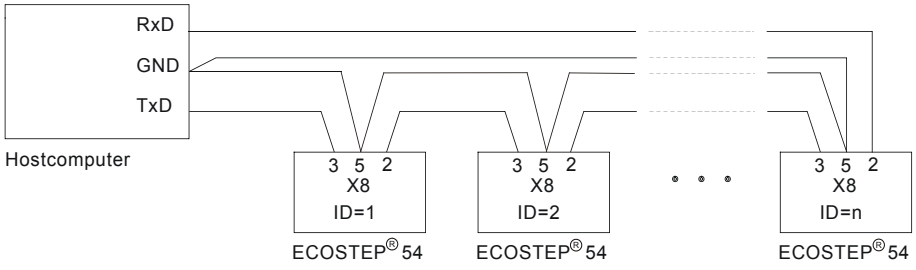


Fig. 6.14: RS232 network as loop structure

6.5 X7: CAN interface

Die CAN interface of the ECOSTEP®54 is based on the communication profile CiA DS 301 and the device profile CiA DSP 402 (drives and motion control). It must be supplied with an external voltage.
Terminating resistors for busses are not built in the ECOSTEP®54. A CAN bus has to be terminated with a 120 Ω resistor at the beginning and at the end. If the ECOSTEP®54 is operated as first or last participant at a CAN bus, it is useful to solder the terminating resistor in the mating connector of X7 between the pins 2 and 7.
The manual „Object Dictionary ECOVARIO® and ECOSTEP®“ contains a detailed description of all available functions.
The Baud rate und the device ID can be set via the appropriate CAN objects. By default the ID is set to 1.

The following baud rates are supported: 1 000 kBit/s, 500 kBit/s, 250 kBit/s, 125 kBit/s, 100 kBit/s, 50 kBit/s. If point of sampling and scan rate (86.7 %, 3-times sampling at all Baud rates) do not meet the demands please get in touch with the technical service of Jenaer Antriebstechnik.

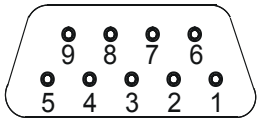


Fig. 6.15: Mating connector X7: 9-pole D-Sub socket; View of the solder or crimp side

Table 6.8: Pin assignment connector X7

Pin	Signal	Description
1	-	n.c.
2	CAN_L	CAN data L
3	CAN_GND	reference potential to CAN data
4	-	n.c.
5	-	n.c.
6	CAN_GND	reference potential to CAN_V+
7	CAN_H	CAN data H
8	-	n.c.
9	CAN_V+	+8 ... + 18 VDC, max. 50 mA

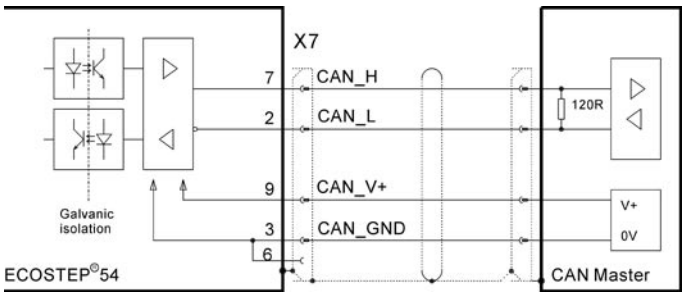


Fig. 6.16: Circuit X7 CAN interface

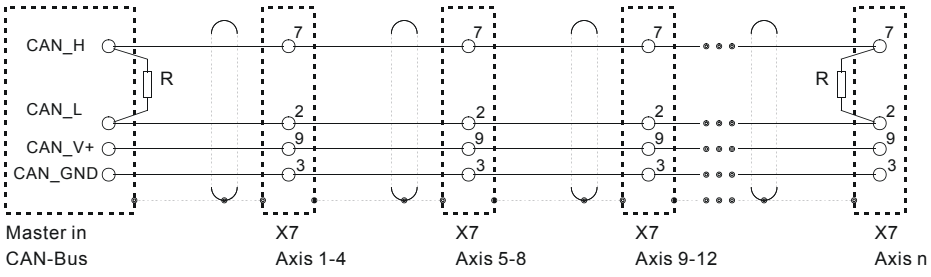


Fig. 6.17: Dimensioning terminating resistors R depending on line impedance; default: R = 120 Ω

7 Commissioning

7.1 Notes before commissioning

Only qualified personnel with a broad knowlege of the fields of electrical engineering, automation and drives are allowed to commission the stepper motor amplifier ECOSTEP®54. If required, Jenaer Antriebstechnik GmbH offers trainings.

The manufacturer of the machine must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

Check the wiring for completeness, short circuits and ground fault.

All live parts must be protected safely against touching.

Never pull the connectors while they are live!

If there are several axes in one machine commission one axis after the other. The axes already commisioned should be switched off.

During operation the temperature of the heat sink and the housing may rise up to over 70 °C. Before touching these parts after switching off the unit wait until the temperature has fallen down to 40 °C.

7.2 Control and display elements

At the front side of the ECOSTEP®54 4 LEDs are located which display status and error messages:

- LED „24V“ (green) on: +24 V logic supply applied
- LED „BUS“ (green), communication display: On, if the first character of a telegram has been received. Goes out as soon as the telegram is processed completely.
- LED „RUN“ (green) flashes: software running, stepper motor amplifier ready for operation
- LED „ERR“ (red) on: error message, cf. chap. 7.3, step 4.

7.3 Work schedule commissioning

1. Check installation
The stepper motor amplifier is disconnected from the supply. Check the wiring for completeness, short circuits and ground faults. For commissioning an RS232 connection via a 1:1 cable from socket X8 to COM1 or COM2 of a PC is required. On PC side also a USB interface can be used. In this case the ECO2USB cable has to be applied, which is available as an accessory (cf. chap. 8).

2. Switch off DC link relay
At the socket X11 no voltage must be applied between the pins REL+ and REL-.

3. Switch on 24 V supply
Apply the 24 V logic supply at the connector X11 between the pins GND and +24 V; after an initializing phase of about 3 s the LEDs show the operation mode of the stepper motor amplifier. Normally, the green LED „RUN“ flashes and the green LED „24V“ is on. If this is not the case, check again the logic supply and reset the stepper motor amplifier by switching off and on again the logic supply.

4. Rectify eventual errors
If the LEDs show an error, i.e. the red „ERR“ LED is on, the error has to be rectified before commissioning. Possible error causes:

- Power supply voltage too low (< 15 V)
- Heat sink temperature too high (> 80 °C)
- internal controller error

For further information on the proceeding in case of an error refer to chap. 7.3.1.

5. Start setup software
Connect a PC to the RS232 interface of the ECOSTEP®54 and start the parameter setup software HWIN54 provided on the adjoined CD-ROM. Beginning from the main menu the individual submenus can be accessed. HWIN54 is operated via the keyboard by means of the following keys:

Table 7.1: Keys for the operation of HWIN

Name	Description
Cursor keys ↑↓	Selection of the respective menu option
ENTER key or Cursor key →	Acceptance of a selected menu option and acceptance of an entered value. A new value entered is first shaded with a black bar. Accepted values are always shaded with a green bar.
ESC key or Cursor key ←	In the menu navigation return to the next higher-level menu. In edit boxes the old value can be restored until the new value is accepted by pressing ENTER.
Blank key	Freeze window
Shortcuts:	
F2	„Error Flags“ window
F3	„Digital Input Configuration“ window
F4, S	Save
F5	„Profile Position Mode“ window
F6	„Profile Velocity Mode“ window
F7	„Profile Torque Mode“ window
F8	„Digital Output Configuration“ window
F9	„Device Control“ window

F10	„Direct Object Editor“ window
r	„Reset“ window
h	„Homing Mode“ window
End	Quit HWIN

An overview of the available shortcuts is also provided via the F1 key.

6. Communication PC - ECOSTEP54, device address
In the main menu select the first menu option „PC Adjustment“.

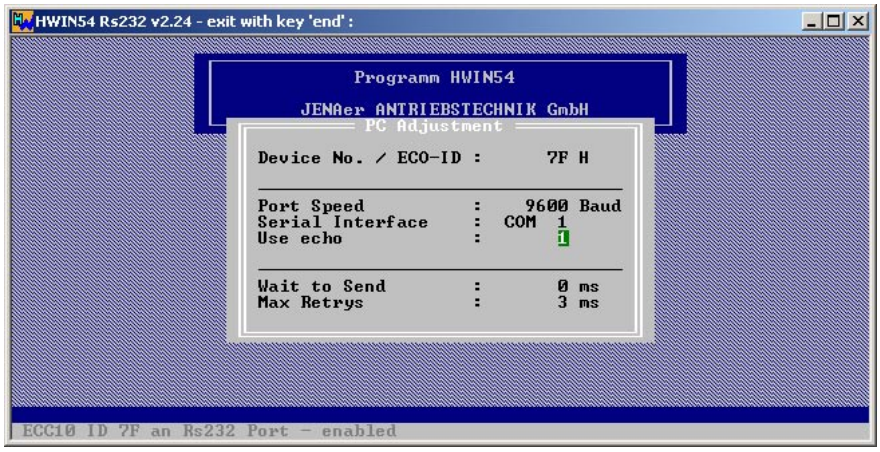

HWIN54 Rs232 v2.24 - exit with key 'end' :
Programm HWIN54
JENAer ANTRIEBSTECHNIK GmbH
PC Adjustment
Device No. / ECO-ID : 7F H
Port Speed : 9600 Baud
Serial Interface : COM 1
Use echo : 1
Wait to Send : 0 ms
Max Retrys : 3 ms
ECC10 ID 7F an Rs232 Port - enabled

Fig. 7.1: Communication settings „PC Adjustment“ at RS232 interface

Set the used COM port. Adapt the baud rate to the interface settings on your PC. By default, the baud rate is set to 9600 Baud. For „Use Echo“ enter „1“. The settings of the parameters „Wait to Send“ and „Max Retrys“ normally do not need to be modified.

➲ Setting Device No. / ECO-ID: The device address (ID) of an ECOSTEP54 is adjusted to 1 by default and results from the sum of object „node-ID“ (Ox100B,00) and object „node-offset“ (Ox2F80,00). The ID can only be changed via the object „node-offset“ (default=0), as the object „node-ID“ is predefined to 1 and cannot be changed. IDs in the range 1 ... 127 can be assigned, whereas each ID must only be assigned once in one network. If you wish to modify the address, first set the „node_offset“ accordingly. After that the new value has to be stored permanently. The new address is then assigned after the +24 V logic supply is switched on again. Each device communicates also via the „Joker-ID“=127 (7Fh), independent of the ID adjusted at the given instant of time, so that even in the event of a false or unknown configuration a single device can be accessed.

6. Set parameters

The parameters have to be adjusted to each individual application. Incorrect parameter settings can cause damage or destruction of machine parts.

The correct setting of the following parameters is especially important. The settings can be done for all 4 motor outputs (Axis 0 to Axis 3) via „Device Profile DS402 -> Profile Torque Mode“ (Shortcut F7):

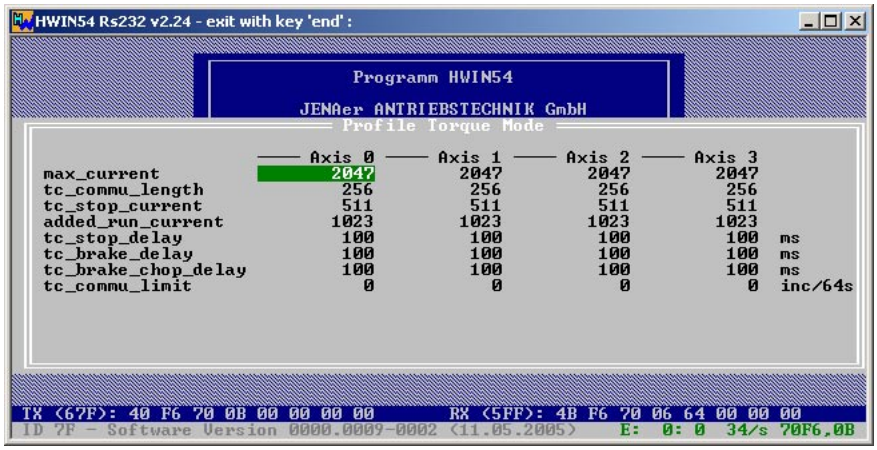

HWIN54 Rs232 v2.24 - exit with key 'end' :
Programm HWIN54
JENAer ANTRIEBSTECHNIK GmbH
Profile Torque Mode
Axis 0 Axis 1 Axis 2 Axis 3
max_current 2047 2047 2047 2047
tc_commu_length 256 256 256 256
tc_stop_current 511 511 511 511
added_run_current 1023 1023 1023 1023
tc_stop_delay 100 100 100 100 ms
tc_brake_delay 100 100 100 100 ms
tc_brake_chop_delay 100 100 100 100 ms
tc_commu_limit 0 0 0 0 inc/64s
TX (67F): 40 F6 70 0B 00 00 00 00 RX (5FF): 4B F6 70 06 64 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005) E: 0: 0 34/s 70F6,0B

Fig. 7.2: Parameter settings for motor and holding brake „Profile Torque Mode" (F7)

- tc_commu_length: step resolution per motor pole -> please take from motor data sheet (Example: step resolution 256 at 50-pole motor results in 12800 steps/resolution).
- max_current: maximum motor current -> please take from motor data sheet.
- tc_stop_current: phase current at standstill -> please take from motor data sheet.
- added_run_current: run current effective in addition to the phase current at standstill -> please take from the motor data sheet.

  Note: The specification of all current values is scaled to the maximum phase current the ECOSTEP54 can provide per motor output. This current amounts to 2.5 A und corresponds to the value 2047. Thus, the value to be specified is calculated as follows:

$$\text{value} = \frac{\text{current value from data sheet [A]}}{2{,}5\ \text{A}} \cdot 2047$$

- tc_stop_delay: Delay [in ms] switchover from run current to stop current
- tc_brake_delay: Delay [in ms] holding brake release after motor current release
- tc_brake_chop_delay: Delay [in ms] holding brake voltage reduction after holding brake release
- tc_commu_limit: Speed value at which switching from sine to rectangular commutation takes place. By switching from sine to rectangular commutation an increase of the torque value is achieved, because at rectangular commutation the motor characteristic can be fully utilized. Unit is inc/64s. At the value 0 sine commutation is activated. The value to be specified is calculated as follows:

$$\text{value} = \frac{\text{speed [in rpm]}}{60\ \text{s}} \cdot 12800\ \text{inc/rev} \cdot 64$$

Note: The resulting motor current is limited to max_current in any case, even if the sum of tc_stop_current and added_run_current exceeds the max_current value.

7. Check safety equipment

Before switching on the voltage it is vital to check if all safety equipment that protects from touching live parts and from the consequences of indeliberate movements functions properly.

8. Configure limit position switches

If the limit position switches at the motor connection X1 ... X4 shall be used, the limit positions can be configured in the „Device Configuration -> Digital Input Configuration“ menu (Shortcut F3).

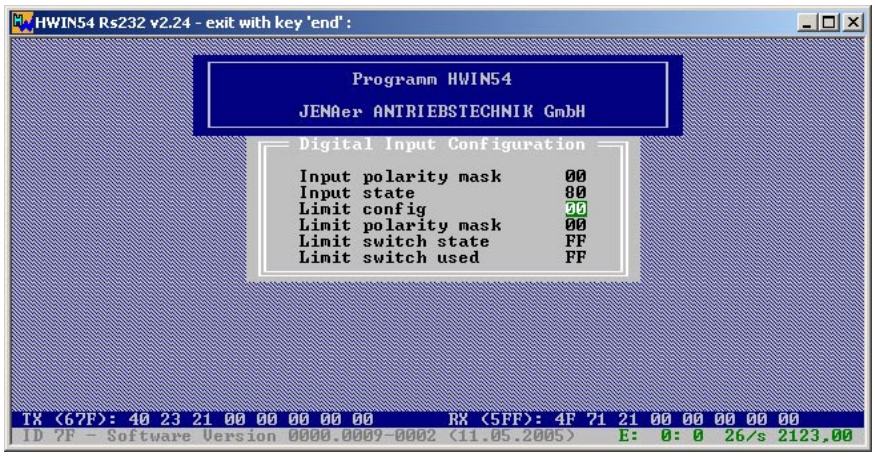

HWIN54 Rs232 v2.24 - exit with key 'end' :
Programm HWIN54
JENAer ANTRIEBSTECHNIK GmbH
Digital Input Configuration
Input polarity mask 00
Input state 80
Limit config 00
Limit polarity mask 00
Limit switch state FF
Limit switch used FF
TX (67F): 40 23 21 00 00 00 00 00
RX (5FF): 4F 71 21 00 00 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005)
E: 0: 0 26/s 2123.00

Fig. 7.3: Configuring the limit position switches in the „Digital Input Configuration“ window (F3)

The following table describes the parameters and the possible settings:

Table 7.2: Parameters of the digital inputs

Parameter	Description		
Input polarity mask	Bit x = 0 -> Input x+1 is A-contact Bit x = 1 -> Input x+1 is B-contact	x = 0 ... 7	A-contact: normally open contact B-contact: break contact
Input state	State of the digital inputs		
Limit config	Bit 0 = 0 -> positive limit position axis 1 at motor connector Bit 0 = 1 -> positive limit position axis 1 at digital input 1 (DIN1) Bit 1 = 0 -> negative limit position axis 1 at motor connector Bit 1 = 1 -> negative limit position axis 1 at digital input 2 (DIN2) ... Bit 7 = 0 -> negative limit position axis 4 at motor connector Bit 7 = 1 -> negative limit position axis 4 at digital input 8 (DIN8)		
Limit polarity mask	Bit 0 = 0 -> positive limit position axis 1 is A-contact Bit 1 = 0 -> negative limit position axis 1 is A-contact ... Bit 7 = 0 -> negative limit position axis 4 is A-contact	Bit 0 = 1 -> positive limit position axis 1 is B-contact Bit 1 = 1 -> negative limit position axis 1 is B-contact ... Bit 7 = 1 -> negative limit position axis 4 is B-contact	
Limit switch state	Status of the limit position switches	see „Limit switch used“	
Limit switch used	Bit 0 = 0 -> positive limit position axis 1 not used Bit 1 = 0 -> negative limit position axis 1 not used ... Bit 7 = 0 -> negative limit position axis 4 not used	Bit 0 = 1 -> positive limit position axis 1 used Bit 1 = 1 -> negative limit position axis 1 used ... Bit 7 = 1 -> negative limit position axis 4 used	

9. Configure holding brake

If the holding brake shall be connected alternatively to connector X5 OUT5 ... 8, the mapping of the respective output has to be set to 0x21240020. AndMask and CmpMask specify the respective output. The settings are done in the menu „Device Configuration -> Digital Output Configuration".

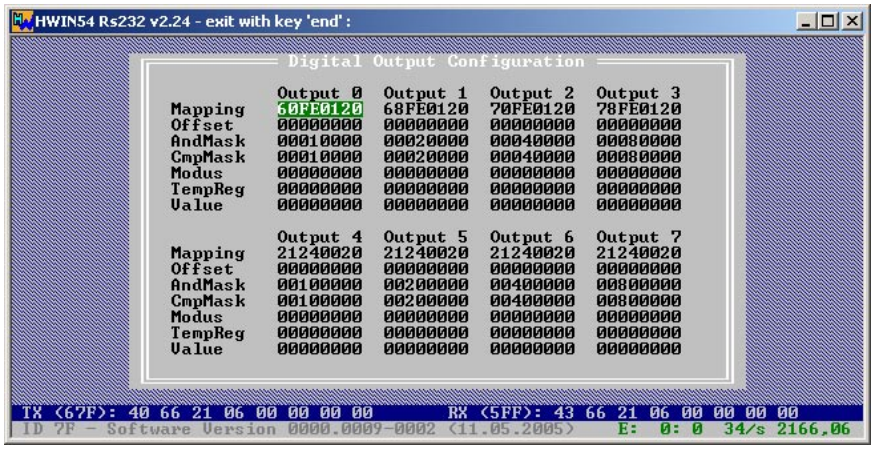


Fig. 7.4: Configuring the holding brake in the window „Digital Output Configuration" (F8)

10. Switch on power supply

11. Switch on DC link circuit

0,5 s after switching on the power supply the DC link circuit relay can be switched on. Therefore, a voltage of + 24V has to be applied across pins REL+ and REL - of connector X11.

12. Set „Switch On" bit in the control word

The drive is switched on by software.
Menu „Separate Axis DS402 -> Device Profile DS402 - Ax -> Device State Control":

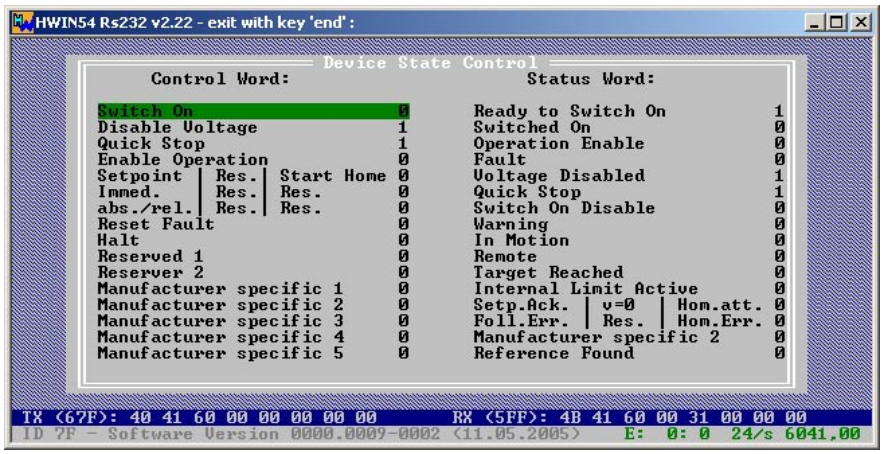

HWIN54 Rs232 v2.22 - exit with key 'end' :
Device State Control
Control Word: Status Word:
Switch On 0 Ready to Switch On 1
Disable Voltage 1 Switched On 0
Quick Stop 1 Operation Enable 0
Enable Operation 0 Fault 0
Setpoint | Res. | Start Home 0 Voltage Disabled 1
Immed. | Res. | Res. 0 Quick Stop 1
abs./rel. | Res. | Res. 0 Switch On Disable 0
Reset Fault 0 Warning 0
Halt 0 In Motion 0
Reserved 1 0 Remote 0
Reserver 2 0 Target Reached 0
Manufacturer specific 1 0 Internal Limit Active 0
Manufacturer specific 2 0 Setp.Ack. | v=0 | Hom.att. 0
Manufacturer specific 3 0 Foll.Err. | Res. | Hom.Err. 0
Manufacturer specific 4 0 Manufacturer specific 2 0
Manufacturer specific 5 0 Reference Found 0
TX (67F): 40 41 60 00 00 00 00 00 RX (5FF): 4B 41 60 00 31 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005) E: 0: 0 24/s 6041,00

Fig. 7.5: Control word and status word in the „Device State Control" window

ECOSTEP54 is controlled via the control word and the status word. In this menu, the bits of both are displayed for each axis separately and the control word can be modified.

13. Set „Enable Operation" bit in the control word

The drive is ready now for further commands. The drive can be switched off any time by resetting the „Enable Operation" bit.

14. Carry out homing procedure

The homing procedure can be carried out according to the following methods. The homing method is selected in the menu „Device Profile DS402 -> Homing mode“ (Shortcut „h“):

Table 7.3: Homing methods of ECOSTEP54 (homing_method)

Value	Description
17	Homing to the negative limit position
18	Homing to the positive limit position
34	Homing to the actual position

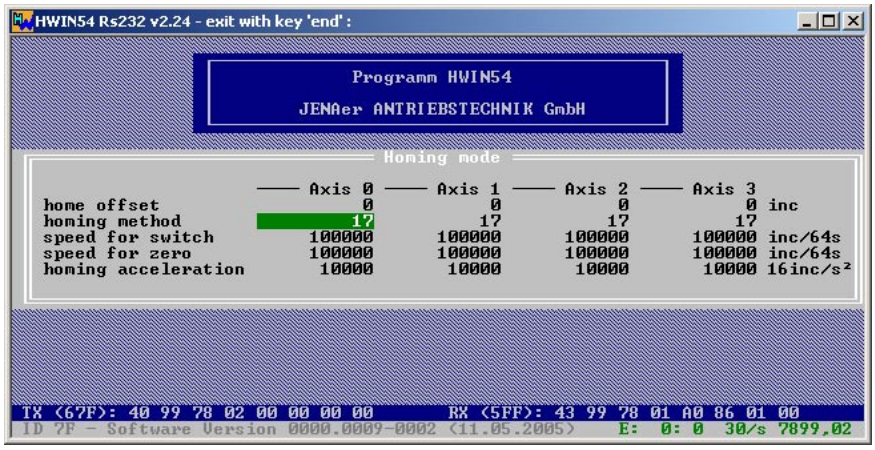

HWIN54 Rs232 v2.24 - exit with key 'end' :
Programm HWIN54
JENAer ANTRIEBSTECHNIK GmbH
Homing mode
Axis 0 Axis 1 Axis 2 Axis 3
home offset 0 0 0 0 inc
homing method 17 17 17 17
speed for switch 100000 100000 100000 100000 inc/64s
speed for zero 100000 100000 100000 100000 inc/64s
homing acceleration 10000 10000 10000 10000 16inc/s²
TX (67F): 40 99 78 02 00 00 00 00 RX (5FF): 43 99 78 01 A0 86 01 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005) E: 0: 0 30/s 7899,02

Fig. 7.6: „Homing Mode“ settings (h)

The following homing parameters can be set in the window:

Table 7.4: Homing parameters at ECOSTEP54

Parameter	Description
home_offset	Reference position shifting (in inc)
homing acceleration	Homing acceleration and deceleration [16 inc/s²]
speed_for_switch	Velocity of the search travel for the reference switch [inc/64 s]
speed_for_zero	Velocity of the search travel for the home position [inc/64 s]

Homing is activated (however, not yet started) in the menu „Device Profile DS402 -> Device Control“ (Shortcut F9) by setting the „modes of operation“ for the respective axis to „6“.

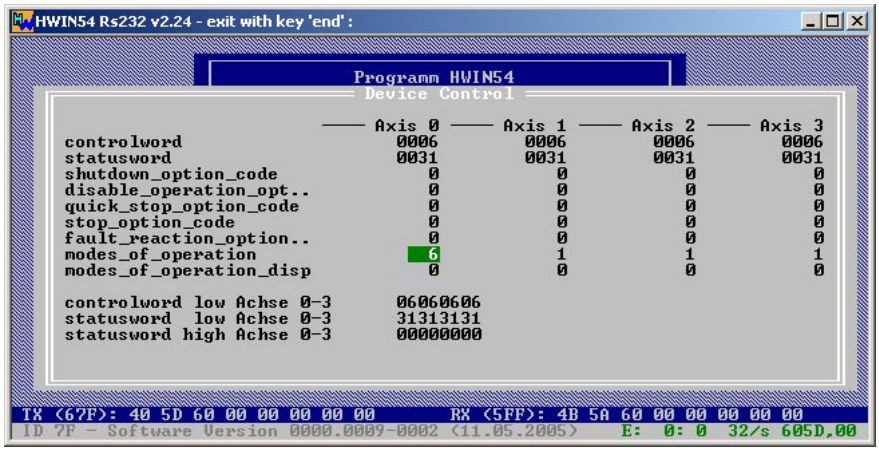

HWIN54 Rs232 v2.24 - exit with key 'end' :
Programm HWIN54
Device Control
Axis 0 Axis 1 Axis 2 Axis 3
controlword 0006 0006 0006 0006
statusword 0031 0031 0031 0031
shutdown_option_code 0 0 0 0
disable_operation_opt.. 0 0 0 0
quick_stop_option_code 0 0 0 0
stop_option_code 0 0 0 0
fault_reaction_option.. 0 0 0 0
modes_of_operation 6 1 1 1
modes_of_operation_disp 0 0 0 0
controlword low Achse 0-3 06060606
statusword low Achse 0-3 31313131
statusword high Achse 0-3 00000000
TX (67F): 40 5D 60 00 00 00 00 00
RX (5FF): 4B 5A 60 00 00 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005)
E: 0: 0 32/s 605D.00

Fig. 7.7: Selecting the mode of operation: Homing (F9)

Homing is started by setting the control word to 001F. Homing can be interrupted by setting the control word to 000F.

By means of the digital outputs you can check whether the reference has been found successfully. In the window „Device Configuration -> Digital Output Configuration“ (Shortcut: F8) map the status word (axis 0: object 60410010 to Output 0, axis 1: object 68410010 to Output 1, axis 2: object 70410010 to Output 2, axis 3: object 78410010 to Output 3). As value for the AND operation enter 0000943F in the „AndMask“ fields. As value for the compare mask enter 00009437 in the „CmpMask“ fields. As soon as the reference for the axis has been found the respective output is set.

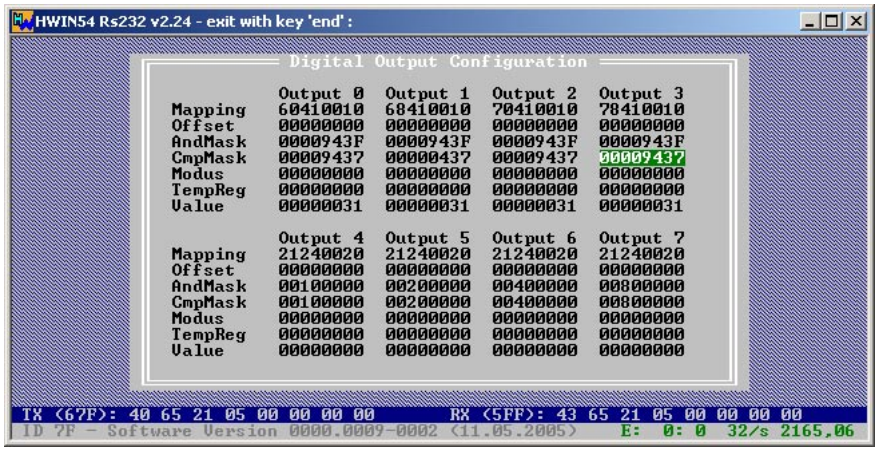


Fig. 7.8: Configuration of the digital outputs (F8)

For PLC programming of the homing procedure you find a flowchart in the Annex (Chap. 9.1).

15. Select operation mode

Besides homing the following operation modes can be selected for the ECOSTEP54 in the menu „Device Profile DS402 -> Device Control“ (Shortcut: F9):

- Profile Position Mode: -> set „modes of operation“ to „1“
- Profile Velocity Mode: -> set „modes of operation“ to „3“

In the Profile Position Mode the following parameters can be configured for the 4 controlled axes in the menu „Device Profile DS402 -> Profile Position Mode“ (axis 0 to axis 3 corresponds to motor output 1 to 4):

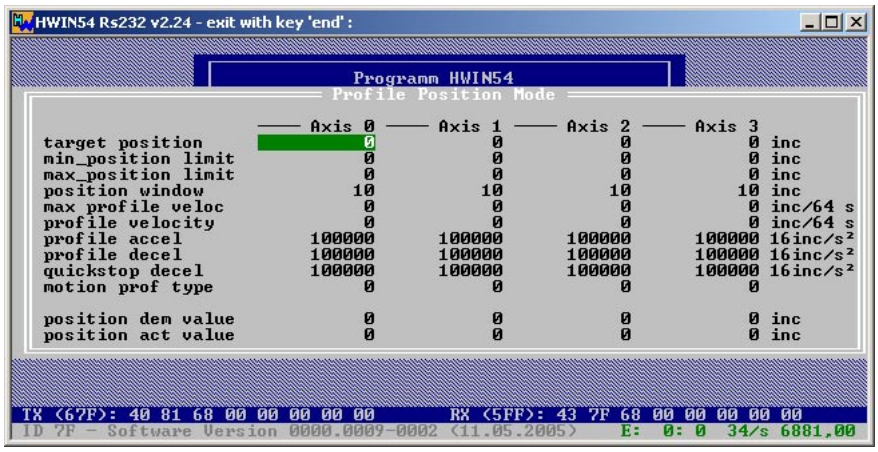

HWIN54 Rs232 v2.24 - exit with key 'end' :
Programm HWIN54
Profile Position Mode
Axis 0 Axis 1 Axis 2 Axis 3
target position 0 0 0 0 inc
min_position limit 0 0 0 0 inc
max_position limit 0 0 0 0 inc
position window 10 10 10 10 inc
max profile veloc 0 0 0 0 inc/64 s
profile velocity 0 0 0 0 inc/64 s
profile accel 100000 100000 100000 100000 16inc/s²
profile decel 100000 100000 100000 100000 16inc/s²
quickstop decel 100000 100000 100000 100000 16inc/s²
motion prof type 0 0 0 0
position dem value 0 0 0 0 inc
position act value 0 0 0 0 inc
TX (67F): 40 81 68 00 00 00 00 00 RX (5FF): 43 7F 68 00 00 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005) E: 0: 0 34/s 6881.00

Fig. 7.9: Operation mode Profile Position Mode (F5)

The parameters are described in the following table.

Table 7.5: Parameters in Profile Position Mode for ECOSTEP54

Parameter	Description
target_position	Target position [inc]
min_position_limit	Negative software limit position [inc]
max_position_limit	Positive software limit position [inc]
position_window	Target window symmetrical around the target position [inc]
max_profile_velo	Limitation of the profile velocity [inc/64 s]
profile_velocity	Profile velocity [inc/64 s]
profile_accel	Profile acceleration [16 inc/s]
profile_decel	Profile deceleration [16 inc/s²]
quickstop decel	Deceleration with „Quick Stop“ [16 inc/s²]
motion_prof_type	Acceleration profile (0: linear acceleration characteristics)
position_dem_value	Position setpoint (motion profile generator output) [inc]
position_act_value	Actual position (identical with position_dem_value) [inc]

The Profile Position Mode is controlled by means of 3 bits of the control word:

Table 7.6: Control word in Profile Position Mode for ECOSTEP54

Control word (binary)	Description
xxxx0xxxx	The target position can be set without immediate positioning
Transition from xx000xxx to xx001xxx	The drive carries out an absolute positioning according to the defaults in the menu „Profile Position Mode“.
Transition from xx100xxx to xx101xxx	The drive carries out a relative positioning according to the defaults in the menu „Profile Position Mode“.
xx011xxx	New absolute target positions become effective immediately

In the Profile Velocity Mode the following parameters can be configured:

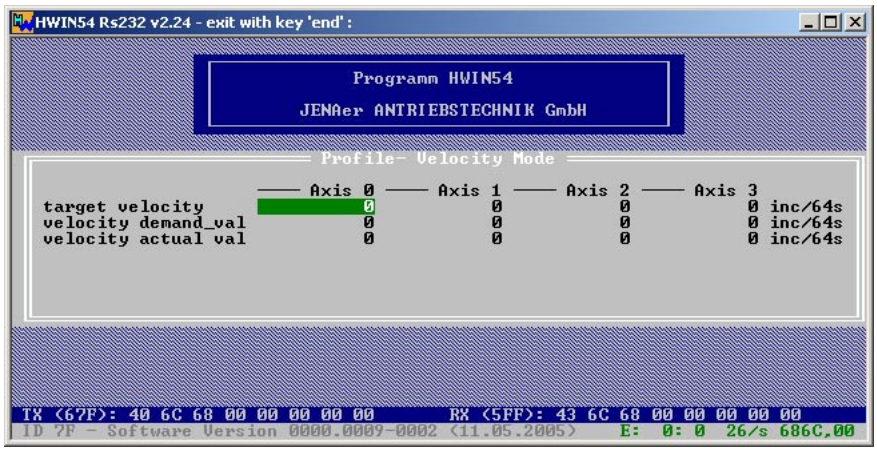

HWIN54 Rs232 v2.24 - exit with key 'end' :
Programm HWIN54
JENAer ANTRIEBSTECHNIK GmbH
Profile- Velocity Mode
Axis 0 Axis 1 Axis 2 Axis 3
target velocity 0 0 0 0 inc/64s
velocity demand_val 0 0 0 0 inc/64s
velocity actual val 0 0 0 0 inc/64s
TX (67F): 40 6C 68 00 00 00 00 00 RX (5FF): 43 6C 68 00 00 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005) E: 0: 0 26/s 686C,00

Fig. 7.10: Parameters in the Profile Velocity Mode (F6)

The parameters are described in the following table.

Table 7.7: Parameters in the Profile Velocity Mode for ECOSTEP54

Parameter	Description
target_velocity	Target velocity in the operation modes 3, -3 and -4 [inc/s]
velocity demand_val	Demanded velocity at the moment [inc/s]
velocity actual_val	Actual velocity value [inc/s]

For PLC programming in positioning mode and velocity mode please refer to the flowcharts in the Annex (Chap. 9.1).

Commissioning of the ECOSTEP®54 is now finished. Further configurable parameters (e.g. communication via CANopen) and sequence programming are described in detail in the manual „Objektverzeichnis ECOSTEP® und ECOVARIO®“.

7.3.1 Error case

If an error occurs the red „ERR“ LED goes on and in the status word (menu „Separate Axis DS402 - Device Profile DS402 - Ax -> Device State Control“) the „Fault“ bit is set.

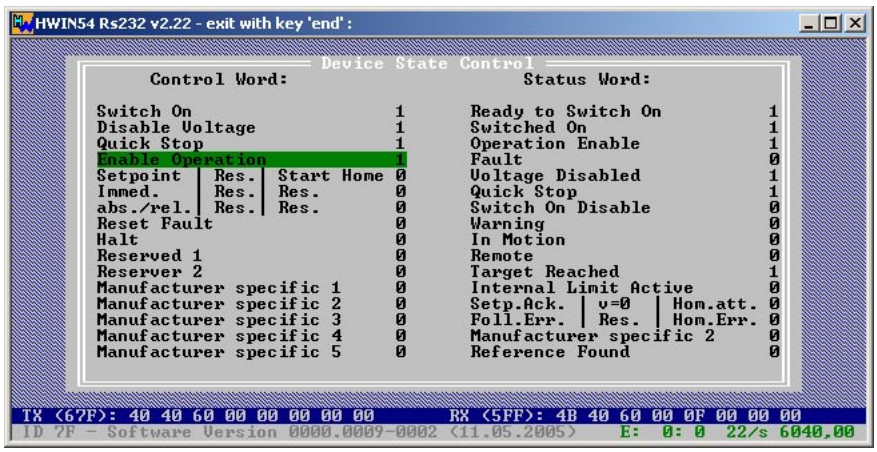

HWIN54 Rs232 v2.22 - exit with key 'end' :
Device State Control
Control Word:
Status Word:
Switch On 1
Disable Voltage 1
Quick Stop 1
Enable Operation 1
Setpoint | Res. | Start Home 0
Immed. | Res. | Res. 0
abs./rel. | Res. | Res. 0
Reset Fault 0
Halt 0
Reserved 1 0
Reserver 2 0
Manufacturer specific 1 0
Manufacturer specific 2 0
Manufacturer specific 3 0
Manufacturer specific 4 0
Manufacturer specific 5 0
Ready to Switch On 1
Switched On 1
Operation Enable 1
Fault 0
Voltage Disabled 1
Quick Stop 1
Switch On Disable 0
Warning 0
In Motion 0
Remote 0
Target Reached 1
Internal Limit Active 0
Setp.Ack. | v=0 | Hom.att. 0
Foll.Err. | Res. | Hom.Err. 0
Manufacturer specific 2 0
Reference Found 0
TX (67F): 40 40 60 00 00 00 00 00
RX (5FF): 4B 40 60 00 0F 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005)
E: 0: 0 22/s 6040,00

Fig. 7.11: „Device State Control“ window with bit by bit representation of the control and status word

Fault conditions are evaluated individually for each axis and displayed in the „Device Profile -> Error Flags“ window (Shortcut F2):

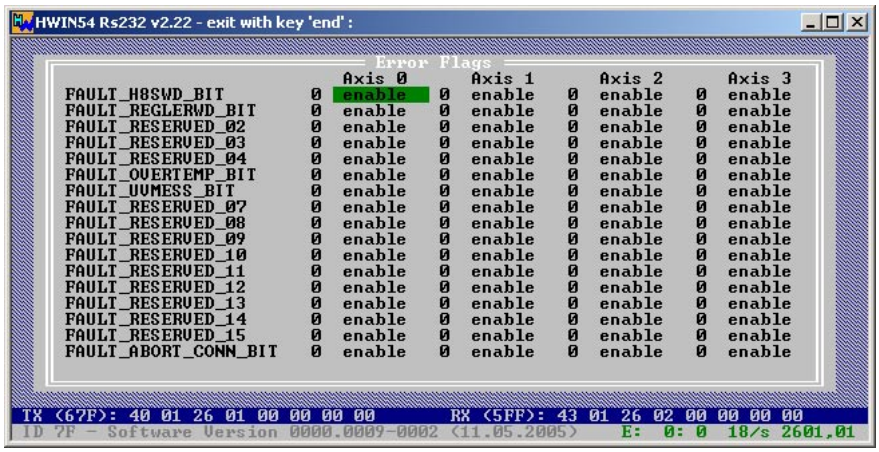

HWIN54 Rs232 v2.22 - exit with key 'end' :
Error Flags
Axis 0 Axis 1 Axis 2 Axis 3
FAULT_H8SWD_BIT 0 enable 0 enable 0 enable 0 enable
FAULT_REGLERWD_BIT 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_02 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_03 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_04 0 enable 0 enable 0 enable 0 enable
FAULT_OVERTEMP_BIT 0 enable 0 enable 0 enable 0 enable
FAULT_UVMESS_BIT 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_07 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_08 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_09 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_10 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_11 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_12 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_13 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_14 0 enable 0 enable 0 enable 0 enable
FAULT_RESERVED_15 0 enable 0 enable 0 enable 0 enable
FAULT_ABORT_CONN_BIT 0 enable 0 enable 0 enable 0 enable
TX (67F): 40 01 26 01 00 00 00 00
RX (5FF): 43 01 26 02 00 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005)
E: 0: 0 18/s 2601,01

Fig. 7.12: Display of the Error Flags (F2)

Table 7.8: Error states in the „Error Flags“ window

Name	Error Description	Measures
FAULT_H8SWD_BIT	Internal controller error	Try to reset the fault condition (cf. page 36). If no success, replace device
FAULT_REGLERWD_BIT	Internal controller error	Replace device
FAULT_OVERTEMP_BIT	Heat sink temperature too high (> 80 °C)	Switch off device. Check heat dissipation.
FAULT_UVMESS_BIT	Power supply voltage too low (< 15 V)	Check voltage
FAULT_ABORT_CONN_BIT	Bus error	Check bus connection and device function

The individual error controls can be selected and activated or deactivated with ENTER.

Note: Fault conditions always lead to the shutdown of the drive, provided that error monitoring is activated for the respective fault condition. Therefore, fault monitoring should be deactivated only in exceptional cases.

After the error cause has been fixed, fault conditions can be reset by a 0 -> 1 transition of the „Reset Fault“ bit in the control word or by a controller reset (Shortcut „r“). After that, the red „ERR“ LED should go out and the„Fault“ bit in the status word should not be set. Otherwise, a fault condition is still present after the reset attempt. Before the drive can be switched on again, the „Switch On“ bit in the control word has to be reset and then set again.

In the „Device Profile DS402 -> Device Control“ window (Shortcut F9) the behaviour of the drive in case of shutdown, Quick Stop and fault conditions is specified:

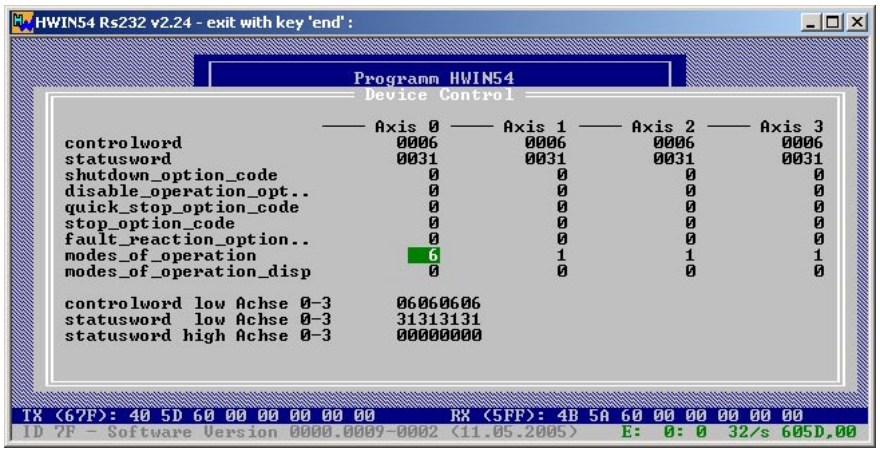

HWIN54 Rs232 v2.24 - exit with key 'end' :
Programm HWIN54
Device Control
Axis 0 Axis 1 Axis 2 Axis 3
controlword 0006 0006 0006 0006
statusword 0031 0031 0031 0031
shutdown_option_code 0 0 0 0
disable_operation_opt.. 0 0 0 0
quick_stop_option_code 0 0 0 0
stop_option_code 0 0 0 0
fault_reaction_option.. 0 0 0 0
modes_of_operation 6 1 1 1
modes_of_operation_disp 0 0 0 0
controlword low Achse 0-3 06060606
statusword low Achse 0-3 31313131
statusword high Achse 0-3 00000000
TX (67F): 40 5D 60 00 00 00 00 00 RX (5FF): 4B 5A 60 00 00 00 00 00
ID 7F - Software Version 0000.0009-0002 (11.05.2005) E: 0: 0 32/s 605D.00

Bild 7.13: Specifying the behaviour of the drive in case of quick stop, shutdown and fault conditions (F9)

Table 7.8: Specifying the behaviour of the drive in case of quick stop, shutdown and fault conditions

Name	Description	Options
shutdown_opt_code (default=0)	Behaviour in case of „Shutdown“	0: Motor de-energized 1: Brakes with profile_deceleration, after that motor de-energized
disable_operation _option_code (default=0)	Behaviour in case of „Disable Operation“	0: Motor de-energized 1: Brakes with profile_deceleration, after that motor de-energized
quick_stop_option_code (default=0)	Behaviour in case of „Quick Stop“	0: Motor de-energized 1: Brakes with profile_deceleration, after that motor de-energized 2, 3, 4: Brakes with Quick Stop deceleration, after that motor de-energized 5: Brakes with profile_deceleration, motor remains current-carrying 6: Brakes with Quick Stop deceleration, motor remains current-carrying
stop_option_code (default=0)	Behaviour in case of„Stop“	0: Motor de-energized
fault_reaction _option_code (default=0)	Behaviour in case of errors	0: Motor de-energized 1: Brakes with profile_deceleration, after that motor de-energized 2, 3, 4: Brakes with Quick Stop deceleration, after that motor de-energized

8 Accessories

Table 8.1: Survey of ECOSTEP®54 accessories

Order key	Description
Heat sink	
SMH41	Heat sink for ECOSTEP®54 with mounting elements
Connector Kit	
SMK40	Socket connector 6-pole (WAGO type 231-306) as mating connector for X11 Strain relief bushing 20 mm and raised-head screw M3 x 12 (Strain relief and shield connection of the connection cables)
Software tools	
	CD with commissioning and parameterization software HWIN54 including documentation for ECOSTEP®54
Cables and adapters	
ECO2USB	Adapter RS232 to USB, used for parameterization of the ECOSTEP®54 via the USB interface of the PC

8.1 Supplementary parts

8.1.1 Heat sink

The heat sink set consists of:

- 1 heat sink SMH41 for ECOSTEP®54
- 6 screws M5x16
- 6 serrated lock washers 5,3 mm

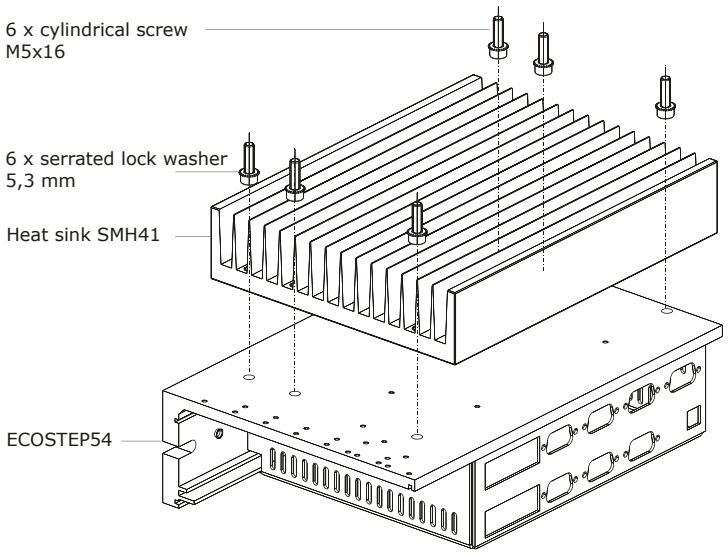


Fig. 8.1: Monting heat sink

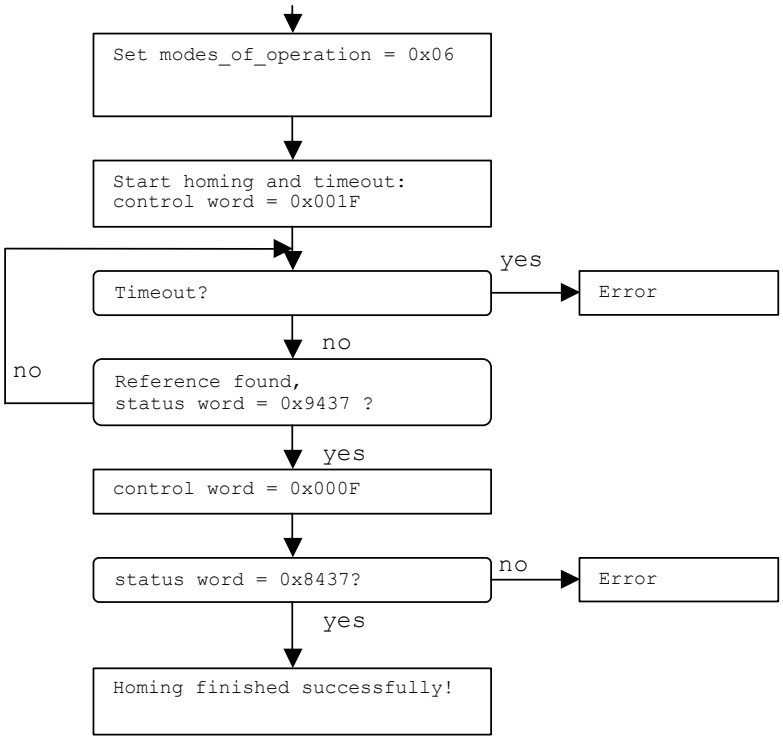
9 Annex

9.1 Flowcharts for PLC programming

9.1.1 Homing

Flowchart homing for ECO54 axis, initial situation after power-on: control word = 0x0006, status word = 0x0031.

For safety reasons every movement of an axis should be monitored by the PLC via timeout.



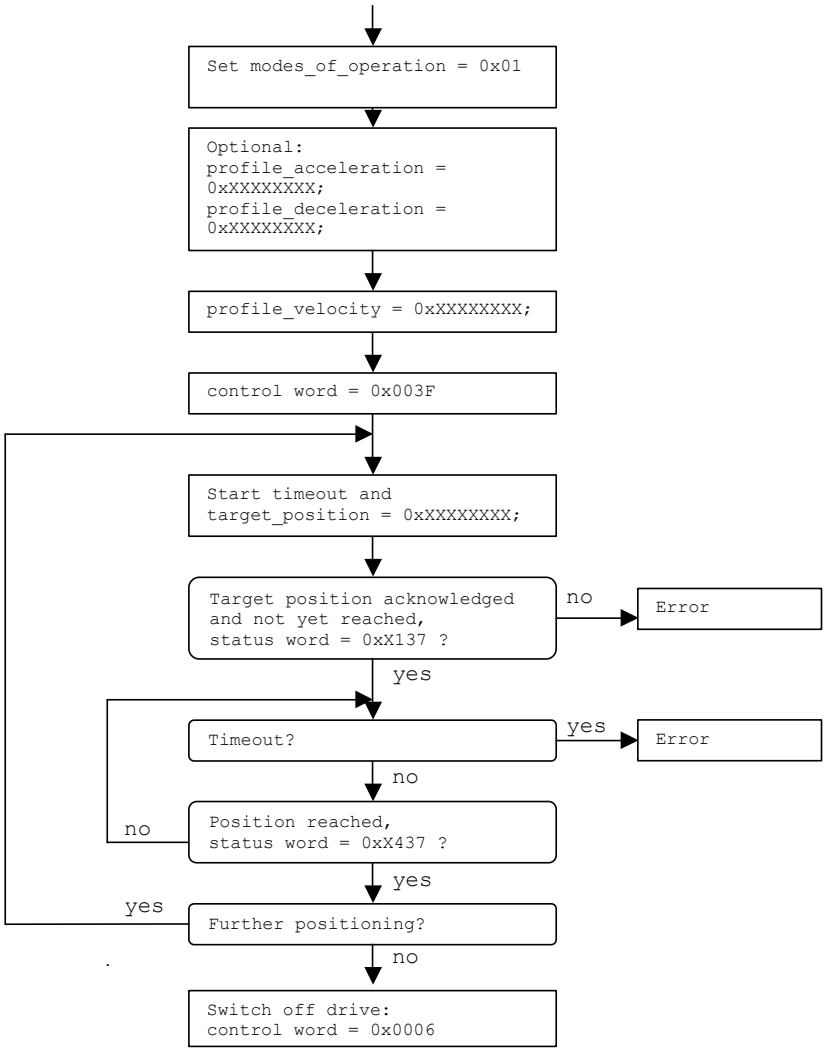
The objects to be written or to be read, resp. for the individual axes are (incl. sub index and length):

	Axis 0	Axis 1	Axis 2	Axis 3
control word	60400010	68400010	70400010	78400010
status word	60410010	68410010	70410010	78410010
modes_of_operation	60600008	68600008	70600008	78600008

9.1.2 Operation mode 1 (Profile Positioning Mode): Direct absolute positioning (effective immediately)

Flowchart positioning mode absolute direct (1) after homing for ECO54 axis.
Status: control word = 0x000F, status word = 0x8437

For safety reasons every movement of an axis should be monitored by the PLC via timeout. The relevant parameters profile_velocity, profile_acceleration, profile_deceleration, quick_stop_deceleration and target_position cannot be manipulated by the PLC if a mapping to other controller parameters (analog input, etc.) exists!



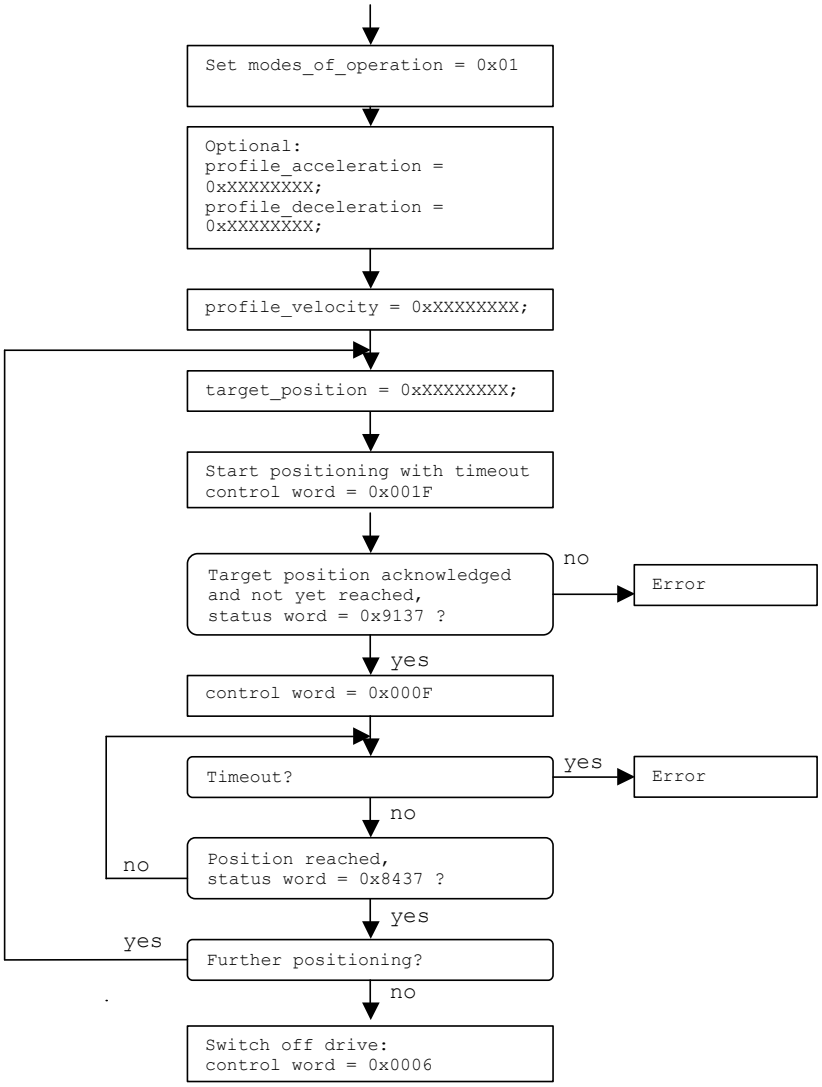
The objects to be written or to be read, resp. for the individual axes are (incl. sub index and length):

	Axis 0	Axis 1	Axis 2	Axis 3
control word	60400010	68400010	70400010	78400010
status word	60410010	68410010	70410010	78410010
profile_velocity	60810020	68810020	70810020	78810020
target_position	607A0020	687A0020	707A0020	787A0020
modes_of_operation	60600008	68600008	70600008	78600008
profile_acceleration	60830020	68830020	70830020	78830020
profile_deceleration	60840020	68840020	70840020	78840020

9.1.3 Operation mode 1 (Profile Positioning Mode): Absolute positioning after setting the control word

Flowchart positioning mode absolute (1) after homing for ECO54 axis 0.
Status: control word = 0x000F, status word = 0x8437

For safety reasons every movement of an axis should be monitored by the PLC via timeout. The relevant parameters profile_velocity, profile_acceleration, profile_deceleration, quick_stop_deceleration and target_position cannot be manipulated by the PLC if a mapping to other controller parameters (analog input, etc.) exists!



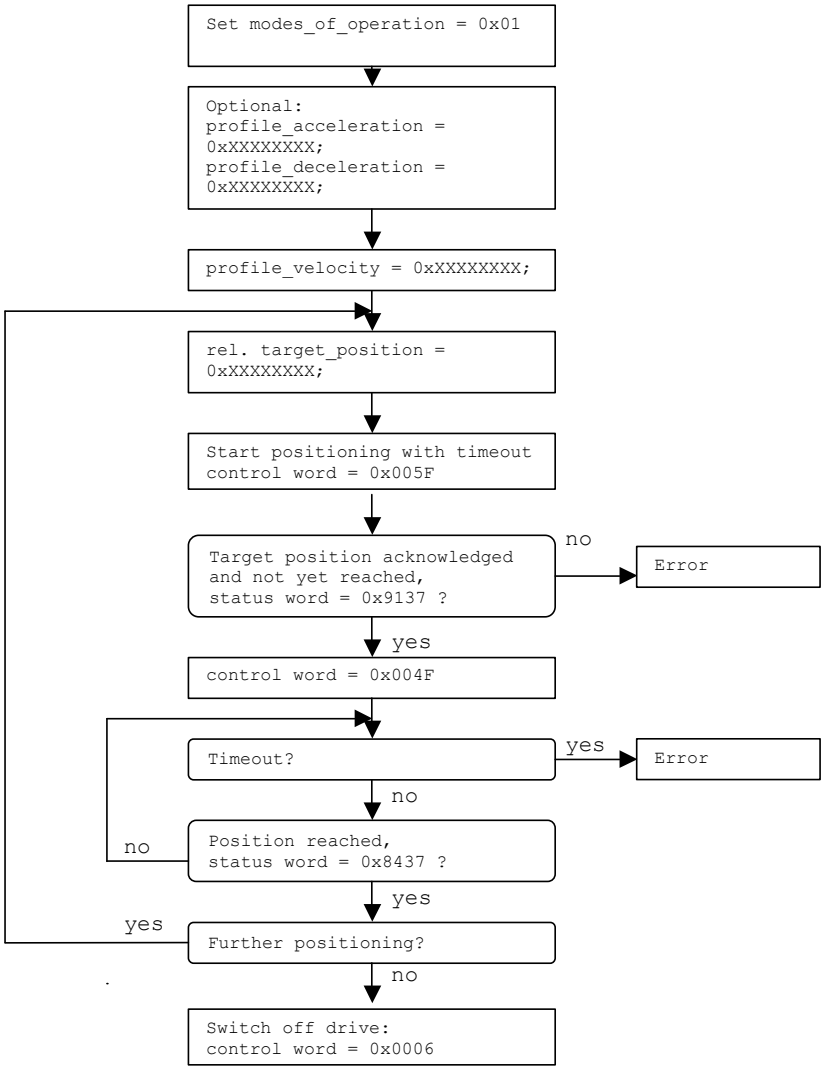
The objects to be written or to be read, resp. for the individual axes are (incl. sub index and length):

	Axis 0	**Axis 1**	**Axis 2**	**Axis 3**
control word	60400010	68400010	70400010	78400010
status word	60410010	68410010	70410010	78410010
profile_velocity	60810020	68810020	70810020	78810020
target_position	607A0020	687A0020	707A0020	787A0020
modes_of_operation	60600008	68600008	70600008	78600008
profile_acceleration	60830020	68830020	70830020	78830020
profile_deceleration	60840020	68840020	70840020	78840020

9.1.4 Operation mode 1 (Profile Positioning Mode): Relative positioning

Flowchart positioning mode relative (1) after homing for ECO54 axis 0, Status: control word = 0x000F, status word = 0x8437

For safety reasons every movement of an axis should be monitored by the PLC via timeout. The relevant parameters profile_velocity, profile_acceleration, profile_deceleration, quick_stop_deceleration and target_position cannot be manipulated by the PLC if a mapping to other controller parameters (analog input, etc.) exists!



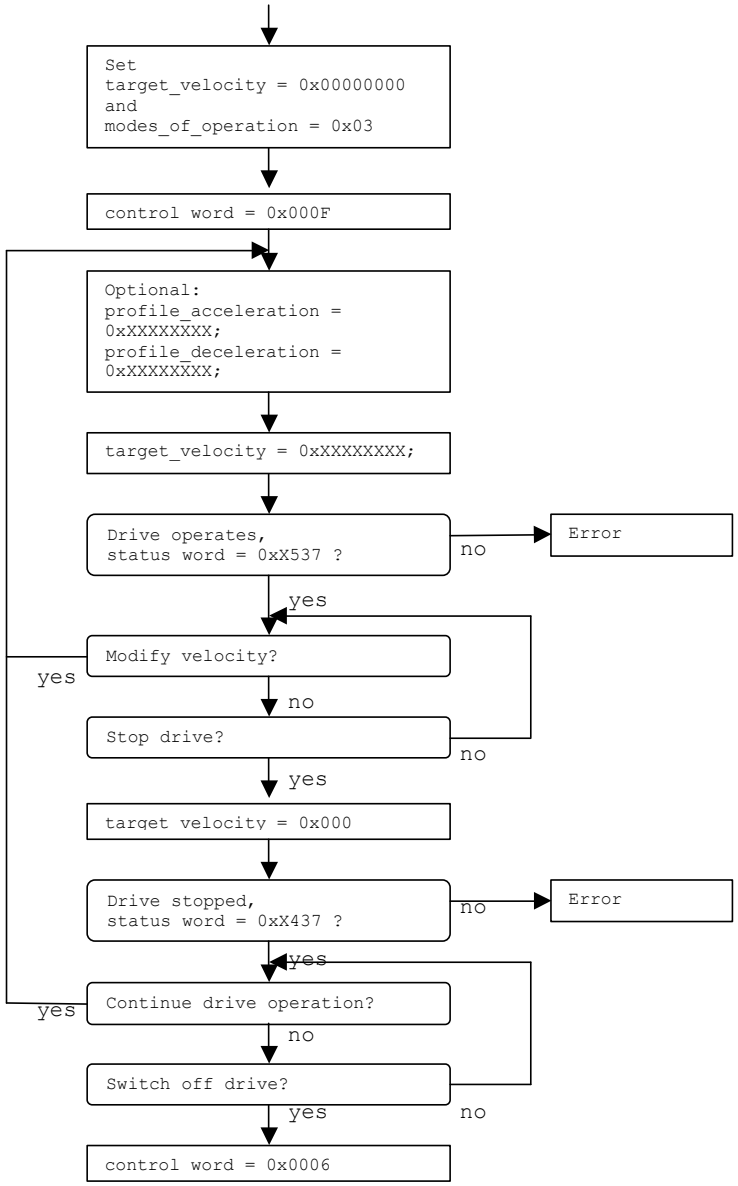
The objects to be written or to be read, resp. for the individual axes are (incl. sub index and length):

	Axis 0	Axis 1	Axis 2	Axis 3
control_word	60400010	68400010	70400010	78400010
status_word	60410010	68410010	70410010	78410010
profile_velocity	60810020	68810020	70810020	78810020
target_position	607A0020	687A0020	707A0020	787A0020
modes_of_operation	60600008	68600008	70600008	78600008
profile_acceleration	60830020	68830020	70830020	78830020
profile_deceleration	60840020	68840020	70840020	78840020

9.1.5 Operation mode 3 (Profile Velocity Mode)

Flowchart velocity mode (3) for ECO54 axis,
Stauts: control word = 0x0006, status word = 0x0031

For safety reasons every movement of an axis should be monitored by the PLC via timeout. The relevant parameter target_velocity cannot be manipulated by the PLC if a mapping to other controller parameters (analog input, etc.) exists!



The objects to be written or to be read, resp. for the individual axes are (incl. sub index and length):

	Axis 0	**Axis 1**	**Axis 2**	**Axis 3**
control word	60400010	68400010	70400010	78400010
status word	60410010	68410010	70410010	78410010
target_velocity	60FF0020	68FF0020	70FF0020	78FF0020
modes_of_operation	60600008	68600008	70600008	78600008
profile_acceleration	60830020	68830020	70830020	78830020
profile_deceleration	60840020	68840020	70840020	78840020

9.2 Data Protocol of the RS232 Interface

Generally, the behaviour of the RS232 interface is according to the CAN standard. The CAN protocol is „tunneled“, i.e., the data is transported within the CAN protocol via the serial interface. As device address the CAN Node ID is used.

RS232 communication uses a strictly master slave relation. The host computer only can initiate any data transfer sending a data telegram to the ECOVARIO® device listening on the TxD line of the host. This device immediatly echoes this byte, i.e. every received byte is transmited to the next device in the loop ensuring that each slave in loop will receive the host telegram. At the end of the loop the host will receive the data was sent. The adressed ECOVARIO® device computes the received data and sends an answer telegram. Depending on device position in the communication loop, this telegram is transported via echo from one device to next and finally to the host.

RS232 communication requires the following interface settings:

- asynchronous communication
- 9600 baud, 8 data bits
- no parity
- 1 stop bit

The transport protocol uses a telegram with a fixed length of 10 bytes.

The host sends:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
ID	8 byte host data								CHKS

Der Host receives the echo (RS232):

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
ID	8 byte host data								CHKS

Der Host receives the answer:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
ID	8 byte slave data								CHKS

ID is the ID No of the addressed slave
CHKS is the telegram checksum. CHKS = -∑(byte 0 .. byte 8)

Note: Each 10 byte telegram has its own checksum.
If the host sends a telegram with an unused ID data will pass the loop but no slave answer will return. In that case the host will receive 10 bytes only. The slave finding its own ID in host telegram checks the CHKS value. If the checksum does not match the slave would not generate an answer.

Acces to the object dictionary via RS232 will work in the same way as CANopen SDO, excluding segmented data transfer. The 8 byte data of the SDO protocol are extended by 1 byte address (node ID) and 1 byte checksum. The arrangement of the 8 byte data is described in the following. Application of the PDO, SYNC, EMCY and NMT objects is not possible via RS232.

9.2.1 Download Request (Data Transfer from Host to Slave)

Any access to object dictionary is checked for validity by slave. Downloads to not existing objects, readonly objects or data type mismatches are denied and responded with error messages.

The host sends:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CMD	INDEX LSB	MSB	SUBINDEX	DATA LSB			..MSB

CMD specifies the direction of data transfer and the size of data object
possible values are:
0x23 sending 4 bytes data (bytes 4 ... 7 contain 32 bit value)
0x2B sending 2 bytes data (byte 4 and 5 contain 16 bit value)
0x2F sending 1 byte data (byte 4 contains 8 bit value)

INDEX 16 bit value, index in object dictionary where data should be placed

SUBINDEX 8 bit value, subindex of index in object dictionary where data should be placed

DATA 8, 16, or 32 bit value

The slave answers:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
RES	INDEX LSB	MSB	SUBINDEX	reserved			

RES displays slave response, possible values are:
0x60 data successfully sent
0x80 error, bytes 4...7 contain error cause

INDEX 16 bit value, index in object dictionary, copy of index in host telegram

SUBINDEX 8 bit value, subindex of index in object dictionary, copy of index in host telegram

reserved not used or error cause, depending on RES

Table 9.1: Example: Writing to the control word (6040,00) value = 0x06 (axis off)

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Transmit:	0x2B	0x40	0x60	0x00	0x06	0x00	0x00	0x00
Receive:	0x60	0x40	0x60	0x00	0x00	0x00	0x00	0x00

9.2.2 Upload Request (Data Transfer from Slave to Host)

Upload from not existing objects is responded with an error message.

The host sends:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CMD	INDEX		SUBINDEX	reserved			

CMD specifies the direction of data transfer
0x40 read access (always)
INDEX 16 bit value, index in object dictionary where requested data reside
SUBINDEX 8 bit value, subindex of index in object dictionary where requested data reside
reserved byte 4 ... 7, not used

The slave answers:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
RES	INDEX LSB	MSB	SUBINDEX	Data LSB			MSB

RES displays slave response, possible values are::
0x43 bytes 4 ... 7 contain 32 bit value
0x4B bytes 4 and 5 contain 16 bit value
0x4F byte 4 contains 8 bit value
0x80 error, bytes 4 ... 7 contain error cause
INDEX 16 bit value, index in object dictionary, copy of index in host telegram
SUBINDEX 8 bit value, subindex of index in object dictionary, copy of index in host telegram
DATA data or error cause, depending on RES

Table 9.2: Example: Reading the status word (0x6041,00)

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Transmit:	40	41	60	00	00	00	00	00
Receive:	4B	41	60	00	37	40	00	00
Value of the status word : 0x4037 (axis switched on, no error)								

9.3 Glossary

Baud rate	Unit of measure for the transmission rate of data in serial interfaces. The baud rate indicates the number of possible changes of state of the transmitted signal per second (1 baud = 1 state change/s). The baud rate can be lower than the bit rate (one bit is coded in several signal states). „Baud rate“ in this document refers to signals in which one bit is defined with the two signal states HIGH and LOW. In this case the bit rate equals the baud rate.
Bitrate	Transmission rate of information in bit/second
Bootloader mode	State of the servo amplifier in which a new loadware can be transmitted into the servo amplifier‘s memory.
DC link voltage	Smoothed DC voltage (here: $U_{DC\text{-}BUS}$)
EMC	Electromagnetic compatibility
ESD protection	Protection against electrostatic discharge
Fieldbus interface	Here: CAN
Firmware	Part of the software tha is stored to ROM (read-only memory), the firmware contains the start-up routines.
Ground fault	Here: electrically conductive connection between a power system or motor phase and the PE conductor
Host	Computer in a multi computer system that controls the whole system
ID number	Identification number of a special device in a bus structure
Loadware	Part of the software that can be stored to the flash memory of the servo amplifier
Node	Device connection in a bus structure
RMS	Root mean square
Short circuit	Here: electrically conductive connection between two power systems or motor phases
Watchdog	Supervisory software

9.4 Index of standards and directives

DIN EN 954-1: Safety of machinery - Safety related parts of control systems - Part 1: general principles for design

DIN EN 50170: General purpose field communication system

DIN EN 50178: Electronic equipment for use in power installations

DIN EN 60 204: Safety of machinery - electrical equipment of machines - Part 1: General requirements

DIN EN 61 800-3: Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods

DIN EN 61 800-5-1: Adjustable speed electrical power drive systems - Part 5-1: Safety requirements; Electrical, thermal and energy

DIN EN ISO 12 100-1: Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology

DIN EN ISO 12 100-2: Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles

IEC 61 000-4-2: Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test

IEC 61 000-4-4: Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test

98/37/EG: Directive of the European Parliament and the Council on the approximation of the laws of the Member States relating to machinery

89/336/EWG: Council Directive on the approximation of the laws of the Member States relating to Electromagnetic Compatibility